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## First description of a giant manta ray fetus *Mobula birostris* (Walbaum 1792) from Tumbes, Peru (Southeast Pacific)

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The population of *Mobula birostris* (“giant manta ray”) found in the waters of northern Peru and Ecuador is believed to be the largest in the world (Harding & Beirwagen, 2009). This species is considered to be the largest within the group of manta rays, as they attain at least 670 cm disc width (reported to 910 cm) (White *et al.*, 2006) and there is a record of an individual weighing 2000 kg (Kunjipal & Boopendranath, 1981). This species is ovoviviparous (matrotrophic viviparous) (Herbert, 2012). A single pup follows a gestation period of approximately one year, (Marshall *et al.*, 2008, Mendonça *et al.*, 2012). Successive pregnancies are speculated to be separated by a refractory period of two or more years (Mendonça *et al.*, 2012). The objective of this study is to record the measurements of a *M. birostris* fetus of a female caught accidentally in the region of Tumbes, Peru. This is the first record of morphological and morphometric data regarding a manta fetus in Peru.

On the 6th of September 2017, an individual of the species *M. birostris* was caught incidentally in the gillnets of an artisanal fishery. The capture of this individual was located approximately 4 miles off the coast of Acapulco, Tumbes, Peru (3°44'S; 80°46'W). The target species of the net was hake. The female was unraveled on the beach due to her size and the limited number of actions that could have been taken at sea. At this point in time the captured manta ray was dying.

Measurements of the manta ray were recorded (disc length: 3030 mm, disc width: 6210 mm) and the abdominal cavity was opened for the collection of some samples (including stomach contents, tissues, etc.). The uterus was dilated, and upon dissection a fetus was detected inside. The fetus was subsequently removed and transferred to the Coastal Laboratory of Tumbes-Institute of the Sea of Peru (LCT-IMARPE). In the laboratory, 37 morphological measurements were recorded based on information from Marshall *et al.* (2008). Three measurements were taken in addition referencing the navel of the fetus. Subsequently, the fetus was fixed in 4% formaldehyde and deposited in the collection of the Biodiversity Area of the LCT-IMARPE. Additionally, the proportions of the body were calculated based on the percentage of the disc length (% DL).

The fetus inside the uterine cavity had its pectoral fins bent over the back of the body. The fins were unfolded in order to take the measurements and observe the entire animal. The ventral surface displayed a whitish-creamy color and a slight pinkish tone with small black spots, forming a semicircle that is present under the fifth branchial opening (Fig. 1a). Colors became fainter posterior to the gill openings (Fig. 1a). Darker tones were observed from the cloaca to the tips of the pectoral fins (Fig. 1a). An umbilical-like stalk terminated in a 10 mm reddish navel (Fig. 1b). The tail had a caudal spine at its base, character key for *Mobula birostris* (Fig. 1c). Patches of dermal denticles were presented in the ventral and dorsal surfaces of the body, as well as in some areas of the cephalic fins; the most notable that were recorded were near the dorsal fin and at the base of the tail. The dorsal surface showed a blackish color, becoming darker in the area near the mouth (Fig. 1d). The inner surfaces of the cephalic fins had black edges with white center areas, and the outer surfaces of the cephalic fins were primarily white (Fig. 1d). In the lower jaw a band of teeth was evident.

The fetus had a disc length of 586 mm, a disc width of 1370 mm and a total weight of 23.6 kg. The morphological measurements are specified in Table 1. The fetus did not present claspers, which indicated that it was a female.

This study is the first detailed description of coloration and morphometric measurements of a *M. birostris* captured in the coast of northern Peru. To date few studies exist on the reproductive biology of this species, therefore emphasizing the importance of these findings. The results reported in this study coincide with the literature regarding the number of offspring per reproductive event. Regarding weight and size at birth, the two captive mantas born in Japan in 2007 (Okinawa Churaumi Aquarium) had disc widths of 1.8 and 1.9 meters, and the latter animal weighted 68.5 kg (Rubin, pers. comm.). So, it could indicate that the fetus analyzed (DW=1.37 m; weight: 23.6 kg) was in a mid to advanced stage of fetal development.



**FIGURE 1.** Female fetus of *Mobula birostris* obtained from an individual captured incidentally in Tumbes, Peru: (a) ventral view, showing identification patterns; (b) ventral view with the pectoral fins bent towards the back, showing the remnant of yolk sac (c) spine at the base of the tail, character key for *Mobula birostris*; (d) dorsal view

In addition, it was observed that the fetus already had pigmentation patterns in the ventral part, which indicates that in *M. birostris* these patterns develop before being born, however it can not be confirmed that the registered patterns are definitive, as suggested by Marshall *et al.* (2008).

Similar to Marshall *et al.* (2008), the fetus of *M. birostris* displayed the presence of an umbilical attachment, which is the remnant of the yolk sac.

A prominent feature found was the fetal position, in which the pectoral fins were found folded on the back. This also coincides with the description by Tomita *et al.* (2012) regarding *M. alfredi*. Moreover, Marshall *et al.* (2008) describe the

same feature in a species of genus *Mobula*. Casas *et al.* (2006) report the same findings for *M. thurstoni*. Therefore, we suggest that this can be considered as the normal fetal position for all species of the genus *Mobula*.

The disc length (DL) of the fetus recorded in Peru was similar to that recorded in Ecuador (Beebe & Tee-Van, 1941), representing 108.52% of the DL. However, the recorded weights display a much greater variation. Those recorded in Peru were substantially higher (185.83%) than those reported from Ecuador. These biometric differences could be due to possible genetic or nutritional effects.

It is pointed out that the presence of *M. birostris* is directly related to the productivity of the area (Dewar *et al.*, 2008), so the high productivity of the Eastern Tropical Pacific (Fiedler *et al.*, 1991) could explain the occurrence of *M. birostris* in the waters of northern Peru.

Besides the gravid manta indicated in this document, three gravid mantas have previously been recorded between August 2012 and May 2013 in this area (Ávila *et al.*, unpublished). This indicates that the occurrence of gravid mantas is not an exclusive event. Together with our recent findings, and previous records, this data reinforces the importance of the north coast of Peru as potential reproduction grounds for *M. birostris*. This information is crucial for the establishment and progression of conservation measures for this migratory species.

**TABLE 1.** Morphological measurements of fetus of *M. birostris* reported in Peru.

| Description                         | mm   | %DL     | Description                                    | mm  | %DL     |
|-------------------------------------|------|---------|--|-----|---------|
| Length of disc                      | 586  | 100.00% | Length of third gill opening                   | 122 | 20.82%  |
| Width of disc                       | 1370 | 233.79% | Length of fourth gill opening                  | 115 | 19.62%  |
| Thickness of disc                   | 114  | 19.45%  | Length of fifth gill opening                   | 94  | 16.04%  |
| Distance from pelvic fin to rostrum | 545  | 93.00%  | Distance between first gill openings           | 140 | 23.89%  |
| Length of cephalic fin              | 156  | 26.62%  | Distance between fifth gill openings           | 76  | 12.97%  |
| Width of cephalic fin               | 70   | 11.95%  | Distance from face to first gill opening       | 102 | 17.41%  |
| Thickness of cephalic fin           | 18   | 3.07%   | Distance from face to fifth gill opening       | 338 | 57.68%  |
| Diameter of right eye               | 16   | 2.73%   | Length pre umbilical                           | 277 | 47.27%  |
| Diameter of left eye                | 16   | 2.73%   | Diameter of umbilicus                          | 1   | 0.17%   |
| Width of cranium                    | 422  | 72.01%  | Distance from umbilicus to end of pectoral fin | 696 | 118.77% |
| Distance between spiracles          | 288  | 49.15%  | Length pelvic fin                              | 120 | 20.48%  |
| Length of spiracle                  | 22   | 3.75%   | Anterior margin of pelvic fin                  | 65  | 11.09%  |
| Width of mouth                      | 193  | 32.94%  | Width of base of pelvic fin                    | 94  | 16.04%  |
| Length of lower band of teeth       | 150  | 25.60%  | Length pre cloacal                             | 524 | 89.42%  |
| Internarial distance                | 136  | 23.21%  | Total length of tail                           | 545 | 93.00%  |
| Length pre dorsal                   | 512  | 87.37%  | Width at base of tail                          | 16  | 2.73%   |
| Length from base of dorsal fin      | 77   | 13.14%  | Width in middle of tail                        | 4   | 0.68%   |
| Height of dorsal fin                | 60   | 10.24%  | Posterior width of tail                        | 2   | 0.34%   |
| Anterior margin of dorsal fin       | 79   | 13.48%  | Anterior height of tail                        | 18  | 3.07%   |
| Length of first gill opening        | 129  | 22.01%  | Height in middle of tail                       | 4   | 0.68%   |
| Length of second gill opening       | 126  | 21.50%  | Posterior height of tail                       | 1.1 | 0.19%   |

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